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Colors and morphology of sources of activity on 67P/Churyumov-Gerasimenko nucleus from OSIRIS/ROSETTA observations

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Abstract

The European Space Agency (ESA) Rosetta mission was launched on 2 Mars 2004 to perform the most detailed study ever attemped of a comet. After ten years of interplanetary cruise, Rosetta enter in orbit around its primary target, the short period comet 67P/Churyumov-Gerasimenko, on August 2014, and followed the comet for more than 2 years until 30 September 2016, when it gently landed on the nucleus surface.
Rosetta had a complex instrumentation, including the Optical, Spectroscopic, and Infrared Remote Imaging System (OSIRIS) which acquired more than 80000 images of the comet during the mission. OSIRIS is composed of two cameras: a Narrow Angle Camera (NAC) for nucleus surface and dust studies, and a Wide Angle Camera (WAC) for the wide-field coma investigations.
OSIRIS has enabled extensive studies at high resolution (down to 10 cm/pixel, and even lower during the Rosetta final descent phase) of the nucleus, and it has monitored the cometary activity and its evolution from 4 AU inbound to 3.6 AU outbound, including the perihelion passage at 1.25 AU.

This work focuses on the identification of the regions sources of faint jets and outbursts, and on the study of their spectrophotometric properties, from observations acquired with the OSIRIS/NAC camera during the July-October 2015 period, i.e. close to perihelion.
More than 200 jets of different intensities were identified directly on the nucleus from NAC color sequences acquired in 7-11 filters covering the 250-1000 nm wavelength range, and their spectrophotometric properties studied.
Some spectacular outbursts appear spectrally blue, due to the presence of grains having very small size and possibly water ice enriched.
Some jets have an extremely short lifetime, appearing on the cometary surface during the color sequence observations, reaching their peak in flux and then vanishing in less than a couple of minutes. These short lived events were observable thanks to the unprecedented spatial and temporal resolution of the ROSETTA/OSIRIS observations.

The observed jets are mainly localized close to boundaries between different morphological regions. Some of this active areas were observed and investigated in higher resolution (up to few dm per pixel) during the last months of Rosetta mission operations. These observations allow us to investigate the link between morphology, composition, and activity on cometary nuclei.

This study indicates that a number of faint outbursts feed continuosly the cometary activity close to perihelion. If some bright events were connected to cliff collapse [1, 2], more in general the faint jets and dust plumes here investigated are originated from different terrains' morphologies: consolidated terrains, active pits, scarps, dust deposits, jumping stones, and cavities.
The main driver of activity is local insolation, with areas close to regional morphological boundaries, under cliff or inside cavities, being the most active ones. These terrains cast shadows thus favorizing volatiles recondensation mostly from the subsurface, during the cometary night, and partially from inner coma molecules back-scattered to the nucleus surface. Approacing perihelion, the cometary dust mantle got thinner [3], and several evidence of diurnal color changes and frost formation close to shadows has been observed and attributed to volatiles condensation during the cometary night [3, 4].
Moreover, several of the jets/outburst sources are lo-

cated in, or close to, areas being brighter and having colors relatively bluer than the comet dark terrain, indicating a local enrichement in volatiles that, once illuminated, sublimate and give rise to the observed jets. A clear example is the Anhur region in the big lobe of the comet, which is the source of several jets, including the spectacular perihelion outburst, and which show several exposure of volatiles at the surface, including the first and unique detection of CO_2 ice [3, 5, 6].

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References

[1] Pajola et al., 2017, Nature Astronomy 1, 0092

[2] Vincent et al., 2016, MNRAS 462, S184

[3] Fornasier et al., 2016, Science 354, 1566

[4] De Sanctis et al., 2015, Nature 525, 500

[5] Fornasier et al., 2017, MNRAS 469, S93

[6] Filacchione G., et al., 2016, Nature 529, 368